

Application of SMART Criteria in Planning Improvements to the Operating Conditions of Machinery

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Abstract. The use of work equipment generates substantial hazards for people involved in their operation and maintenance. The scope of improvements in the field should be selected with an eye to eliminating hazards and minimizing the impact of harmful, dangerous and onerous factors caused by the use of machinery. In order to develop solutions, implement them successfully and assess the results, it is advisable to apply the SMART criteria. Such criteria, which are widely known and commonly used in quality engineering, allow for the identification of crucial characteristics of specific technical and organizational solutions with a view to assuring safety.

Keywords: SMART criteria, improvement plan, technical and organizational devices, operation.

1 Introduction

Due to exposures to hazards of persons using technical machinery and equipment during their day-to-day operation and maintenance, there is a need to apply certain impact mitigation measures in keeping with the criteria set out in Directive 2009/104/EC [2]. The prime responsibility for ensuring compliance with the relevant requirements rests with employers and persons in charge of securing worker safety in working environments [1]. The Directive itself stops short of specifying the technical and organizational measures required to ensure compliance with the minimum requirements. The scope and method of achieving improvements should be selected with the view to either eliminating risks or mitigating the impact of any deleterious, hazardous and onerous factors which come into play in the course of using work equipment. The measures should be designed to allow for effective deployment and to be acceptable by the concerned parties [5], [6], [8]. In planning the effective deployment of appropriate solutions and, most importantly, in evaluating courses and outcomes of action, use may well be made of the SMART principles known from quality engineering. These help identify the desired significant scope of technical and organizational solutions designed to achieve safety objectives [3], [7].

2 Description of the SMART Criteria

The purpose of evaluating improvement measures is to ensure that the desired objectives can be achieved. This is particularly true for evaluations designed to ascertain that technical equipment can be operated without exposing workers to hazards. Such evaluations are to provide clarity on whether the expected outcomes can in fact be attained. To this end, a methodology is needed for ensuring that the measures at hand will be assessed objectively. Evaluations of the proposed measures may rely on the SMART principle where each letter of the acronym stands for a specific concept [3], [7]:

- **S** as in specific (unambiguous identification) – the scope of measures corresponds to the scope of a company's operations, its mission, its position at a given time and the circumstances to be assessed,
- **M** as in measurable – wherever possible, outcomes should be assessed against specific numerical values or clear statuses to verify compliance,
- **A** as in agreed upon – evaluations based on objectives which workers accept and recognize as appropriate and likely to produce the expected results,
- **R** as in realistic – refers to objectives to be achieved – the objectives should be attainable and account for existing internal and external factors, including the available resources,
- **T** as in time-bound – having a clearly defined time horizon and tasks attainable within the anticipated time.

By adjusting the SMART principles to the specific health and safety requirements associated with the operation of technical equipment, it becomes possible to evaluate objectives (and the circumstances in which they are to be achieved) and consequently confirm the effectiveness of any planned measures.

3 Practical Application of SMART Criteria

3.1 Guidelines for Measures Aimed at Improving Machine Operation Safety

Before implementing improvement measures designed to achieve the desired level of safety, it is necessary to set objectives derived from conclusions from a prior assessment the existing system's compliance with minimum requirements [1], [8]. Such a plan should specify the scope of improvements and ways in which outcomes of improvement measures are to be evaluated. Selected criteria for assessing the compliance of a plan with safety requirements and methods of implementation designed to achieve such compliance are given in Table 1. The assessment should also enable the assessor to ascertain whether:

- the proposed measures will contribute to mitigating the existing risks,
- any new risks may be triggered by deploying the proposed measures,
- any more effective and cost-efficient alternative arrangements are available,

Table 1. Selected criteria to be applied in assessing measures designed to improve the safety of conditions in which equipment is operated

- clearly formulate all necessary measures,
- assign responsibility for the achievement of objectives to proper services, teams and persons,
- specify the resources needed to achieve such objectives,
- set a schedule for the achievement of the adopted objectives,
- define indicators for the assessment of the degree to which the plan has been accomplished and the agreed objectives achieved,
...

- the workers agree with the need to adopt the measures and regarding their effectiveness,
- the proposed measures will be put into practice.

Risks may be considered acceptable if their occurrence is communicated in keeping with applicable laws [3], [5]. To select the scope to which technical and organizational measures designed to mitigate risks will be implemented, one needs to rely on well-tested guidelines which guarantee success. Before one can carry out the specific measures, it is essential to formulate clear detailed requirements ensuring interpretations beyond doubt and an assessment of implementation methods.

3.2 Application of SMART Criteria to Evaluate Equipment (Case Study)

By applying the SMART criteria, one can assess the potential for improving the conditions in which equipment is operated. The criteria help ascertain the achievement of the desirable status prescribed in risk assessment documentation concerning risks related to machinery operation. Once properly adjusted to suit the specific measures taken to improve operating safety, the SMART guidelines will facilitate the assessment of any proposed measures for effectiveness. In the case at hand, the assessment concerns a honing machine, as shown in Figure 1. A survey of the existing solutions suggested that multiple adjustments were needed to ensure the machine meets the minimum operating requirements set out in Directive 2009/104/EC [2]. Some of the selected measures undertaken in the case are given in Table 2.



Fig. 1. Honing machine for which improvement measures have been identified

Table 2. Selected measures undertaken to ensure the machine satisfies minimum requirements as laid down in Directive 2009/104/EC

<p>Organizational measure:</p> <ul style="list-style-type: none"> - Train maintenance personnel charged with the day-to-day use of equipment and authorize the successfully trained workers to perform work. The training shall cover safe work guidelines concerning the use of the relevant equipment. Until the end of the current month, responsibility for achieving this measure shall rest with the Head of Training.
<p>Technical measure:</p> <ul style="list-style-type: none"> - Fit all equipment in use with guards preventing direct contact with moving parts. Such guards shall be designed not to hamper work or reduce efficiency. Until December 15 of this year, responsibility for achieving this measure shall be rest with the Head of Maintenance.

An assessment of the scope of measures (Table 2) designed to adjust equipment to minimum requirements is provided in Table 3.

Table 3. Assessment of solutions adopted to adjust the equipment for compliance with the minimum work safety requirements

Assessment criterion	Compliance assessment	Solution adopted
S specific	compliant	<ul style="list-style-type: none"> - technical equipment fitted with guards covering moving parts, - organizational solutions in place prevent the performance of work at equipment by persons unauthorized to work by employer
M measurable	compliant	<ul style="list-style-type: none"> - protective items fitted on all equipment in use, - maintenance workers authorized to perform work
A agreed upon	compliant	<ul style="list-style-type: none"> - workers trained in work safety and given access to protective items, - users of technical equipment aware of risks involved in wrong use
R realistic	compliant	<ul style="list-style-type: none"> - funds designated for deployment and guard fitting appropriated from overhaul budget, - the fitted guards improve safety without hampering work, - the fitted guards sufficiently protect workers from contact with moving parts, - only allowing duly authorized workers to work does not reduce the capacity to complete work and use equipment
T time-bound	compliant	<ul style="list-style-type: none"> - moving part guards to be fitted by 12/15/13, - workers to be authorized to perform work by the end of current month.

The assessment proved that the scope of improvements was compliant with the SMART principles. This, in turn, shows that once applied, the proposed solutions will bring the working environment into compliance with the minimum safety requirements.

4 Conclusions

Identification of the safety objectives needed to achieve the desired level of safety in the operation of technical equipment as well as the desired scope of preventive and corrective measures forms an integral part of technical equipment adjustments to mandatory legislative requirements [4], [6], [8]. To guarantee the desired level of safety, it is essential to evaluate the adopted solutions. Evaluations should additionally extend to the planning and deployment of organizational and technical measures designed to rule out or minimize hazards and consequently improve working conditions. By using the SMART criteria to assess measures designed to improve conditions for the use of technical equipment, it is possible to gain certainty as to the effectiveness of the adopted measures. The end result is certainty as to whether the improvements in place are indeed appropriate.

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